

WHAT WE CLAIM IS:

1           1. The method of applying abrasive materials  
2 to a substrate, comprising the steps of:  
3           a) forming a relatively small pool of  
4 superheated molten metal at the surface of a metal  
5 substrate by creating an interaction area on the  
6 substrate with a localized high energy source;  
7           b) injecting a powder system into the  
8 pool, the system comprising metal matrix powder and  
9 abrasive powder and the abrasive powder including  
10 abrasive particles having an encapsulating thermal  
11 insulating layer for preventing the abrasive particles  
12 from being melted by the molten metal in the pool; and  
13           c) moving the energy source relative to  
14 the substrate and thereby allowing the pool to  
15 resolidify.

1           2. The method of claim 1, including the step  
2 of:  
3           a) selecting a powder system having a  
4 thermal insulating layer with a melting point in excess  
5 of the melting point of the encapsulated abrasive  
6 particle.

1                   3. The method of claim 1, including the step  
2 of:

3                   a) selecting a powder system having a  
4 thermal insulating layer with a melting point less than  
5 the temperature of the superheated molten metal of the  
6 pool.

1                   4. The method of claim 3, including the step  
2 of:

3                   a) encapsulating the abrasive particles  
4 in an insulating layer having a thickness sufficient to  
5 prevent the abrasive particles from being melted.

1                   5. The method of claim 4, including the step  
2 of:

3                   a) encapsulating the abrasive particles  
4 in an insulating layer having a melting point in excess  
5 of the melting point of the abrasive particles.

1                   6. The method of claim 1, including the step  
2 of:

3                   a) selecting a powder system having  
4 abrasive particles selected from the group consisting of  
5 aluminum oxide, zirconium oxide, chromium carbide, and  
6 silicon carbide.

1           7. The method of claim 1, including the step  
2 of:

3                 a) selecting a powder system having the  
4 thermal insulating layer selected from the group  
5 consisting of nickel, cobalt, iron, titanium, chromium,  
6 hafnium, niobium, molybdenum, tungsten, and alloys  
7 thereof.

1           8. The method of claim 1, including the step  
2 of:

3                 a) selecting the abrasive powder from  
4 the group consisting of nickel coated zirconium oxide and  
5 tungsten coated aluminum oxide.

1           9. The method of claim 1, including the  
2 further step of:

3                 a) selecting a powder system having an  
4 equal volume ratio of the matrix powder to the  
5 particulate powder.

1           10. The method of claim 4, including the step  
2 of:

3                 a) encapsulating the abrasive particles  
4 in an insulating layer having a thickness not exceeding  
5 150 microns.

1               11. The method of claim 7, including the step  
2   of:

3               a) selecting as the insulating layer of  
4   the powder system a metal which is contained within the  
5   matrix powder.

1               12. The method of claim 1, including the  
2   further steps of:

3               a) selecting a precipitation hardenable  
4   alloy as the metal of the substrate; and  
5               b) selecting a matrix powder adapted for  
6   preventing crack formation in the substrate during  
7   resolidification of the pool.

1               13. The method of claim 1, including the step  
2   of:

3               a) machining the resolidified pool and  
4   thereby exposing some of the abrasive particles.

1               14. The method of claim 12, including the step  
2   of:

3               a) selecting a matrix powder which has a  
4   weight predominance of one of nickel and cobalt.

1               15. The method of claim 1, including the step  
2   of:

3               a) selecting as the insulating layer a  
4   material which has a low level of oxidation resistance at  
5   high temperatures.

1               16. The method of claim 1, including the step  
2   of:

3               a) selecting as the abrasive powder an  
4   abrasive particle having a plurality of coatings forming  
5   the insulating layer.

1               17. The method of applying an abrasive coating  
2   to a substrate, comprising the steps of:

3               a) providing a precipitation hardenable  
4   superalloy substrate;

5               b) providing a matrix blend comprising  
6   fine metal powder and fine coated particulates, the  
7   coating on the particulates formed from a metal and  
8   providing an encapsulating thermal insulating layer;

9               c) forming a superheated molten pool of  
10   the superalloy by irradiating a portion of the surface of  
11   the substrate with a laser;

12              d) dispersing the matrix blend within  
13   the pool and continuing to irradiate the pool until the  
14   metal powder and at least the surface of the insulating

15 layer melt and mix with the superalloy in the pool and  
16 thereby form an alloy mix; and  
17                   e) solidifying the alloy mix by ceasing  
18 irradiation of the pool.

1                   18. The method of claim 17, including the step  
2 of:  
3                   a) selecting as the metal of the  
4 coating a metal contained within the metal powder.

1                   19. The method of claim 17, including the step  
2 of:  
3                   a) selecting for the substrate a  
4 superalloy having a predominance by weight of one of  
5 nickel and cobalt.

1                   20. The method of claim 19, including the step  
2 of:  
3                   a) selecting the metal of the coating  
4 from the group consisting of nickel, cobalt, iron,  
5 titanium, chromium, hafnium, niobium, molybdenum, and  
6 tungsten, and alloys thereof.

1               21. The method of claim 20, including the step  
2   of:

3               a) selecting the particulates from the  
4   group consisting of oxides or carbides of aluminum,  
5   zirconium, chromium, and silicon.

1               22. The method of claim 17, including the step  
2   of:

3               a) providing the coating of the  
4   particulates to a thickness of from about 50 to 150  
5   microns.

1               23. The method of claim 22, including the step  
2   of:

3               a) providing a coating which is bonded  
4   to the particulates.

1               24. The method of claim 23, including the step  
2   of:

3               a) providing a coating formed from a  
4   plurality of layers.

1               25. The method of claim 17, including the step  
2    of:

3               a) dispersing the matrix blend into the  
4    pool by injecting the metal powder and the coated  
5    particulates at a rate of from about 0.27 to about 0.30  
6    grams per second.

1               26. The method of claim 25, including the step  
2    of:

3               a) providing a matrix blend having equal  
4    volume proportions of the metal powder and the coated  
5    particulates.

1               27. The product of the process of claim 17.